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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Cement Mill Machinery Lubrication

TEXACO

REG. T. M.

PUBLISHED BY

THE TEXAS COMPANY

TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICATION RECOMMENDATIONS FOR
CEMENT MILL MACHINERY
Crushing and Grinding Machinery

JAW CRUSHERS

Pitman Bearings	
Waste Pad Lubricated (According to Temperatures)	Texaco Thuban 90 or 140 Texaco Pinnacle Cylinder Oil Texaco Pelican Oil
Grease Cup Lubricated	Texaco Cup Grease No. 3, No. 5 or Texaco Marfak No. 3
Eccentric and Other Wearing Parts	
Oil Lubricated	Texaco Crusher Oil or Texaco Pelican Oil
Grease Lubricated (According to Means Provided)	Texaco Cup Grease No. 3 or No. 5

CENTRIFUGAL MILLS

Oil Lubricated	Texaco Pelican Oil or Texaco Altair Oil
Grease Lubricated	Texaco Cup Grease No. 3, No. 5 or Texaco Starfak Grease H

GYRATORY CRUSHERS

Eccentric Bearings, Gears, Ball Bearings and Countershaft	
Warm Weather Operation	Texaco Crusher Oil or Texaco 747 Oil
Cold Weather Operation	Texaco Algol Oil or Texaco Texol E or F
Suspension and Wearing Rings (At Top of Main Shaft)	Texaco Crusher Oil
Grease Lubrication	Texaco Star Grease

BALL, TUBE AND COMPEB MILLS

Shaft Bearings—Grease Lubricated (According to Temperatures)	Texaco Marfak No. 0 Texaco Cup Grease No. 3 or Texaco Hytex Grease No. 6
Oil Lubricated	Texaco Aleph Oil or Altair Oil, or Texaco Pelican Oil
Trunnion Bearings—Wool Yarn Packed	Texaco Crusher Oil
Otherwise	Texaco Hytex Grease No. 6
Thrust Bearings, etc.—Bath Lubricated	Texaco Pinnacle Cyl. Oil
Gears and Pinions	Texaco Thuban 140 or Texaco Crater No. 1

(Continued on Inside Back Cover)

LUBRICATION

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Cement Mill Machinery Lubrication

THE use of concrete for building and highway construction purposes is often too casually accepted. It stems from a huge industry — cement. There is more or less of a direct tie-up between the cement industry and virtually every other phase of manufacture today.

Cement is unique in that it involves a very low-priced raw material. Treatment and handling of this latter, however, is extensive; hence, the value of the finished product. The power consumed in the several processes of handling and grinding must, of necessity, be high, due to the heavy duty required of the machinery. Lubrication must be given very careful attention for it directly affects power costs and production efficiency. Failure of a crusher, a conveyor pump, or a kiln tied up, due to impaired lubrication, may easily disrupt the production schedule, especially if this occurs when rush orders must be filled.

PROCESSES INVOLVED

While cement can be manufactured in one of several ways, i.e., the dry process, the semi-dry process or the wet process, the general run of machinery employed will be very much the same except that in the wet and semi-dry process the "slurry" must be pumped to the various grinding mills and storage tanks prior to evaporation and burning. Conveyors are used in the dry process for this purpose.

CRUSHING AND GRINDING

Crushing and grinding involves two distinct operations:

— First, the raw material must be reduced in size. This means delivering the raw product to the jaw crusher, hammer mill, or gyratory for primary breaking.

— Second, it must be pulverized. Here the hammer mill, gyratory or centrifugal pulverizer fit in.

The Jaw Crusher

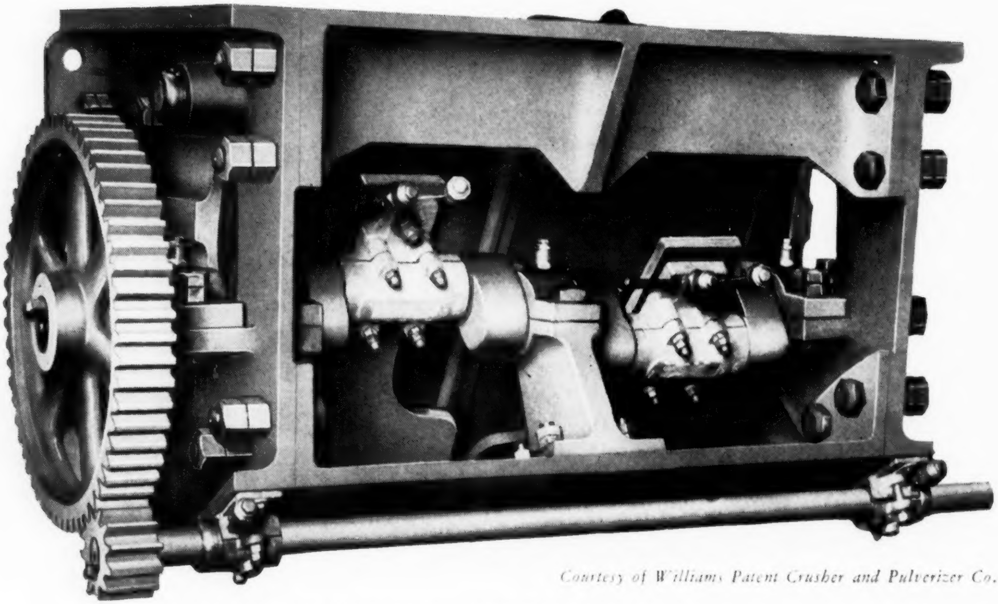
In the jaw crusher we are concerned with the bearings of the pitman and the eccentric shaft. The former carry the pitman or heavy steel casting which oscillates with its bearing as the point of suspension to bring about the requisite degree of crushing.

The Pitman

The pitman bearing is often water cooled; in addition, in certain larger crushers it is relieved of much of the weight by the use of links and coiled springs.

Grease is very often the most adaptable lubricant, being applied to the bearing either by means of pressure lubricators or via reservoirs equipped with wool waste or some other form of pad retainer to insure positive lubrication. Where pressure lubrication is employed, a medium to heavy cup grease will frequently be satisfactory. Wool, waste or pad lubrication however, requires a thinner lubricant, relatively fluid in consistency, for the lubricant must penetrate the wool readily.

The objective is the same in either case; the lubricant must be capable of reaching the lower bearing surfaces where pressure and friction are the greatest. Certain builders provide for delivery of grease (under pressure) to both the top and bottom of the bearings to assure of most positive lubrication.



Courtesy of Williams Patent Crusher and Pulverizer Co.

Figure 1—Front view of the non-clog mechanism of a Williams heavy-duty hammer crusher.

Eccentric Bearings

The weight of the pitman must be compensated for by springs, etc., otherwise its weight will be exerted upon the eccentric shaft bearings, with the probable result that the lubricant will be unable to penetrate and maintain the requisite friction-reducing film at these points.

So crusher construction always must be taken into consideration. Where springs and links are used to balance the pitman, pad lubrication using a light grease will probably work satisfactorily on the eccentrics. Where the weight of the pitman is exerted on the eccentric bearings, as well as on its own supports, pressure lubrication with a heavier grease will give more positive protection.

Hammer Mills

Hammer mills are impact crushers. As the material is crushed it passes to a hopper at the bottom of the mill. In some plants the product is passed to external screens where oversize particles are separated and returned to the hammer mill for further reduction in size.

The type of mill controls the points requiring lubrication. In general, there will be the roll shaft bearings, and in certain machines, the hammer roll bearings and pinion shaft bearings. Certain hammer rolls are mounted upon roller bearings enclosed in dust-proof housings. They normally operate in a bath of oil, the source of which is a large reservoir fixed to the end of the hammer roll shaft. A straight mineral crusher oil of sufficient viscosity to insure adequate body and the prevention of metallic contact at the operating temperatures should be used on such bearings. Plain bearings in turn normally require a medium to heavy grease.

Centrifugal Mills

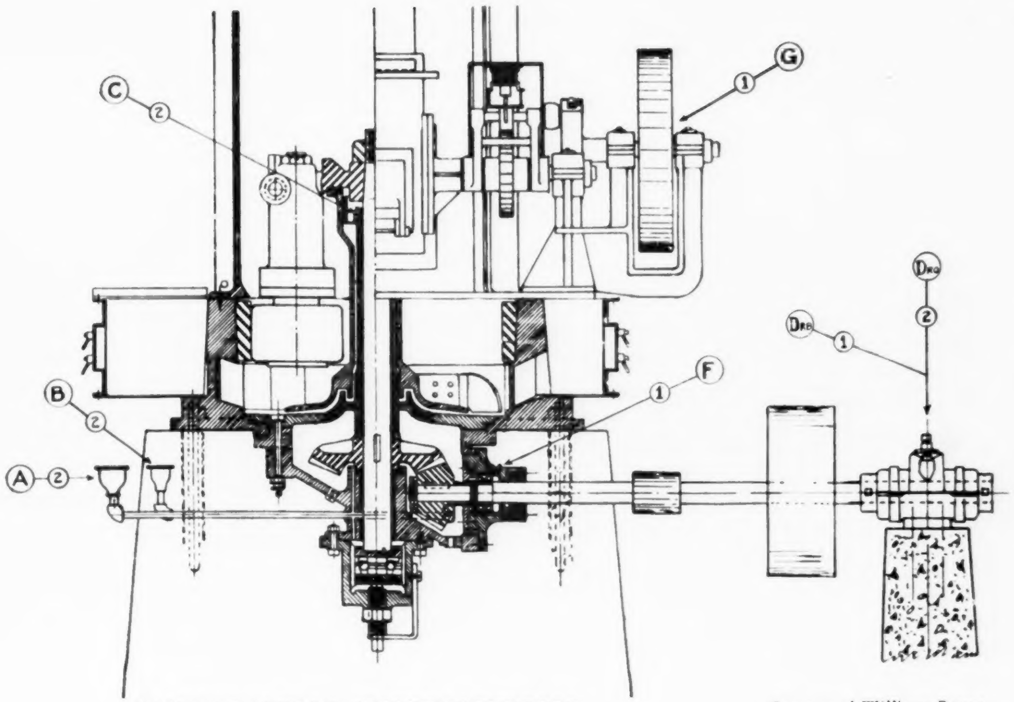
In a centrifugal mill a set of balls, or rolls, move around the internal circumference of a wearing ring or die. This develops considerable pressure against the die especially in the centrifugal roll mill; the material is ground between the rolling elements and this die. In operation the main shaft bushings require lubrication. Heavy oil or grease is generally used. The intermediate bearing of the ball type mill however, is more inaccessible; here grease lubrication has been found to be most dependable.

The lower bushing and thrust bearing are arranged to operate in a bath of oil. Steam cylinder oil or crusher oil may be used successfully for such lubrication, but when the gear drive and ball thrust bearing are incorporated in the same housing, only lubricants suitable for ball bearing lubrication should be used. Where driving gears are involved they may be successfully operated in a bath of light gear lubricant or medium viscosity oil.

Roll Shaft Lubrication

The roll shaft bearings on the centrifugal mill sometimes may present a lubrication problem. Pressures on these bearings are relatively high, some rollers weighing several hundred pounds.

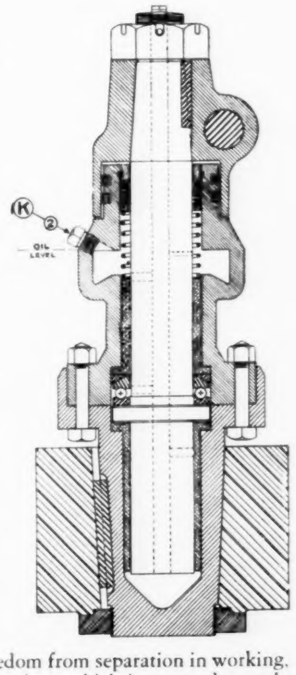
When the bearings are grease lubricated the course of the lubricant is by gravity from the reser-



Courtesy of Williams Patent Crusher and Pulverizer Co.

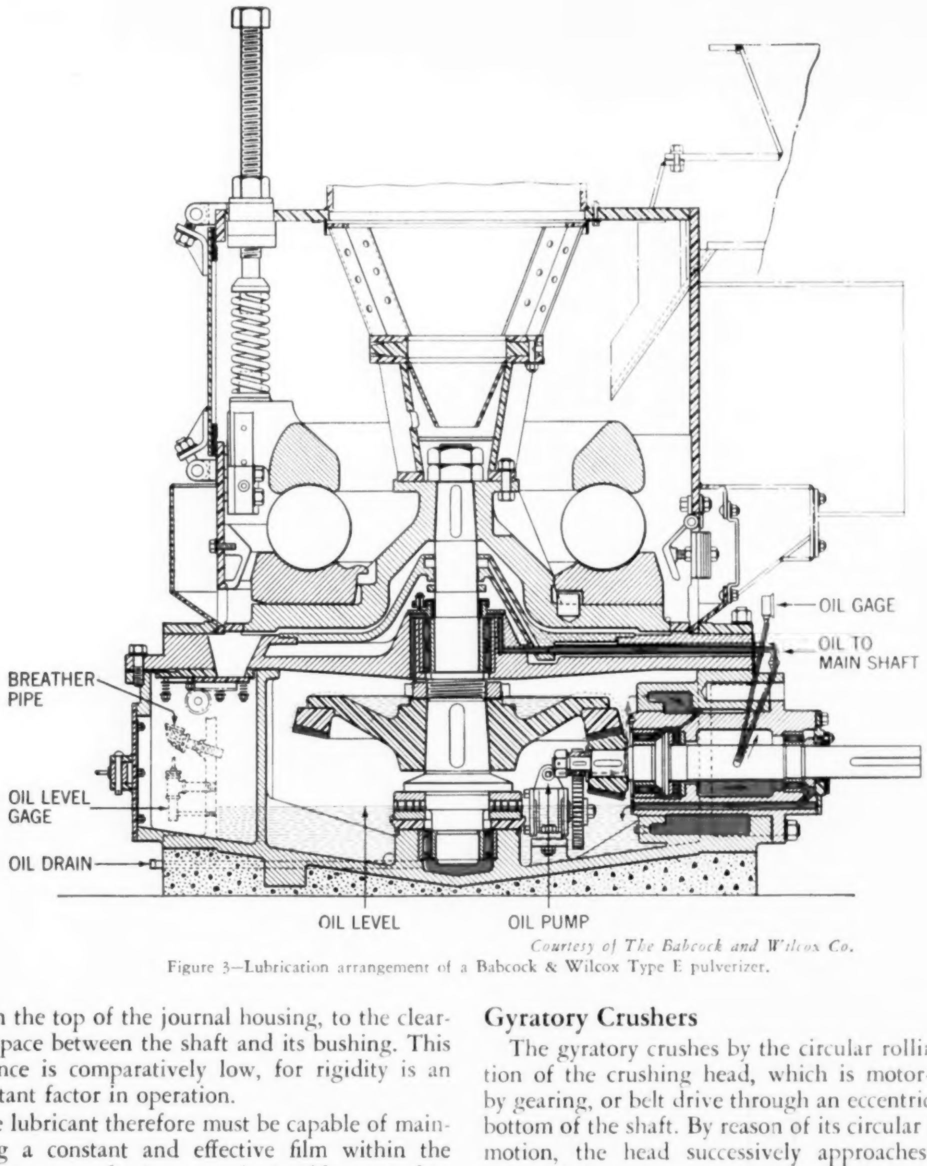
LUBRICATING INSTRUCTIONS
for Williams Roller Mills

Location	*Portions Lubricated*	*Type Lubricant*	*Frequency of Lubrication* (*Small Mills*)	(*Medium and Large Mills*)
A	Lower Bronze Bushing, Step Box Thrust Bearing, (Overflow to Oil Reservoir in Gear Housing)	2	Inspect Daily—Keep Filled But Permit Excess to Overflow from Top of Oil Cup	Inspect Daily and Keep Filled
B	Bevel Gears	2	(Also Lubricated from "A" on Small Mills)	Inspect Daily—Keep Filled But Permit Excess to Overflow from Top of Oil Cup
C	Upper Bronze Bushing, Middle Bronze Bushing	2	. . . .	Inspect Daily—Keep Filled
Dro	Outboard Bearing (If Ring Oiling Type)	2	Inspect Weekly	Inspect Weekly
Dbr	Outboard Bearing (If Ball or Roller Type)	1	Inspect Weekly	Inspect Weekly
E	Upper Bronze Bushing	1	Several Turns Daily, Refill When Necessary	. . . .
F	Inboard Bearing	1	Weekly or Oftener as Required	Weekly or Oftener as Required
G	All Bearings on Feeder Mechanism	1	As Required	As Required
H	Fan Bearings (Not Shown)	1	Weekly or Oftener as Required	Weekly or Oftener as Required
K	Roller Journals	2	Check Oil Level Daily, Keep Filled to Proper Height	Check Oil Level Daily, Keep Filled to Proper Height



Lubricant No. 1 should be a soda-soap grease having a high resistance to oxidation, freedom from separation in working, and no tendency to corrode the highly polished surfaces of the ball and roller bearings which it must adequately lubricate.

Lubricant No. 2 should be a high-quality mineral oil having the characteristics of ready separation from water and high-chemical stability; with viscosity approximately 900 seconds Saybolt at 100 degrees F.



Courtesy of The Babcock and Wilcox Co.
Figure 3—Lubrication arrangement of a Babcock & Wilcox Type E pulverizer.

voir in the top of the journal housing, to the clearance space between the shaft and its bushing. This clearance is comparatively low, for rigidity is an important factor in operation.

The lubricant therefore must be capable of maintaining a constant and effective film within the clearance space; furthermore, it should not tend to leak past the seal at the base of the bushing.

Frequency of re-lubrication will depend upon the nature of the grease, the extent of vibration and the operating temperature. Generally, a fairly heavy grease will be best especially if its oil content is of sufficiently high viscosity to assure of a lubricating film which will withstand the pressures involved, and the vibratory action.

It is also practicable to use oil for the roll shaft bearings by providing a suitable reservoir and means for delivery or circulation to the bearings. Circulation can be developed automatically via suitable grooving cut around the base of the roll shaft.

Gyratory Crushers

The gyratory crushes by the circular rolling motion of the crushing head, which is motor-driven by gearing, or belt drive through an eccentric at the bottom of the shaft. By reason of its circular rolling motion, the head successively approaches every point of the interior of the throat. This action results in a continuous breaking of the material which subsequently falls through at that point of the throat from which the head is most distant.

The gyratory crusher will frequently give a misimpression as to the extent to which its operation depends upon lubrication. Its lubrication is not as simple as it would seem. Due to the peculiarities of construction and the heavy duty involved, gyratory lubrication is oftentimes a matter of considerable difficulty. Not only are the bearings frequently exposed to a great deal of grit and dust and subject to extremes of temperature, but some of them also carry tremendous loads.

How Construction Influences Lubrication

As mentioned, the gyratory crusher may be of the geared or gearless type. The gear driven crusher has two points requiring lubrication which are not found on those employing the gearless drives; i.e., the gear and countershaft bearings.

The chief difficulty in lubricating countershaft bearings involves dust or grit contamination, so they are generally oil-lubricated by sight feed cups or ring oilers, using an oil of from 500 to 900 seconds Saybolt Universal Viscosity at 100° Fahr., according to the speed which rarely exceeds 600 R.P.M.

While ring oiling is a refinement it is of advantage in that any grit or dust is washed from the journal and carried into the reservoir. This latter, on the other hand, must be of adequate capacity. Furthermore, it must be cleaned frequently otherwise grit will accumulate, to ultimately result in serious abrasion of the journal and bearing due to impaired lubrication. Counter shafts are often fitted with outboard bearings, as these steady the shaft and take a great deal of load off the main bearing.

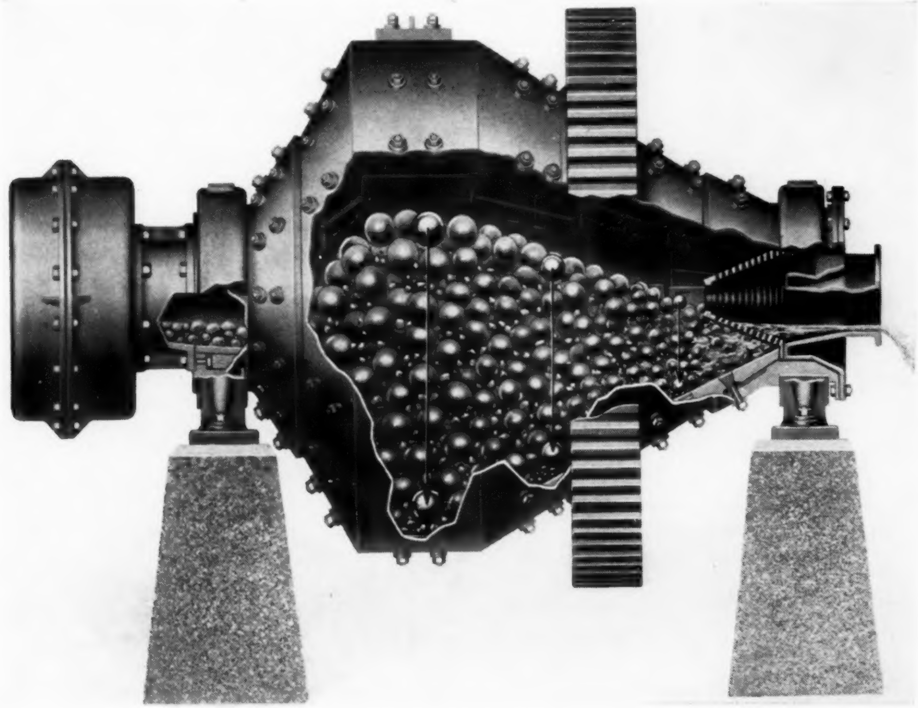
Gear Lubrication

Gears are subjected to severe duty in crusher service. Dust rings are fitted about the shaft where it enters the gear case and all openings are covered, but despite all these precautions a certain amount of dust and finely broken rock will find its way into the gear case, to contaminate the gear lubricant. The latter therefore must not be too thin or low in viscosity, otherwise the film developed on the gear teeth will have insufficient body to prevent grit from coming into actual contact with the gear teeth to cause abrasion as they pass into mesh. A straight mineral oil of from 90 to 145 seconds Saybolt universal at 210° F. will function well under these conditions.

The lubricant must resist the drying action of the dust and prevent its packing between the teeth of the gears. This might cause the gears to spring and throw unnecessary pressure upon the counter-shaft bearings and eccentric. Where a crusher may have to operate in cold weather, heating elements are installed in the oil reservoirs so as to be sure the oil is fluid. Pre-heating when starting cold at the beginning of a shift in the winter, is most important. Pre-heating will insure against drag, excessive power consumption and the possibility of wear.

The Eccentric

As that part which imparts the gyratory motion to the shaft the eccentric requires very careful lubrication. As the eccentric revolves within a bushing and about the shaft, there are two surfaces to be lubricated. In addition, there is the brass wearing



Courtesy of Hardinge Company

Figure 4—Cutaway of a Hardinge conical mill showing relative size of balls, the drive gear and bearing pedestals.

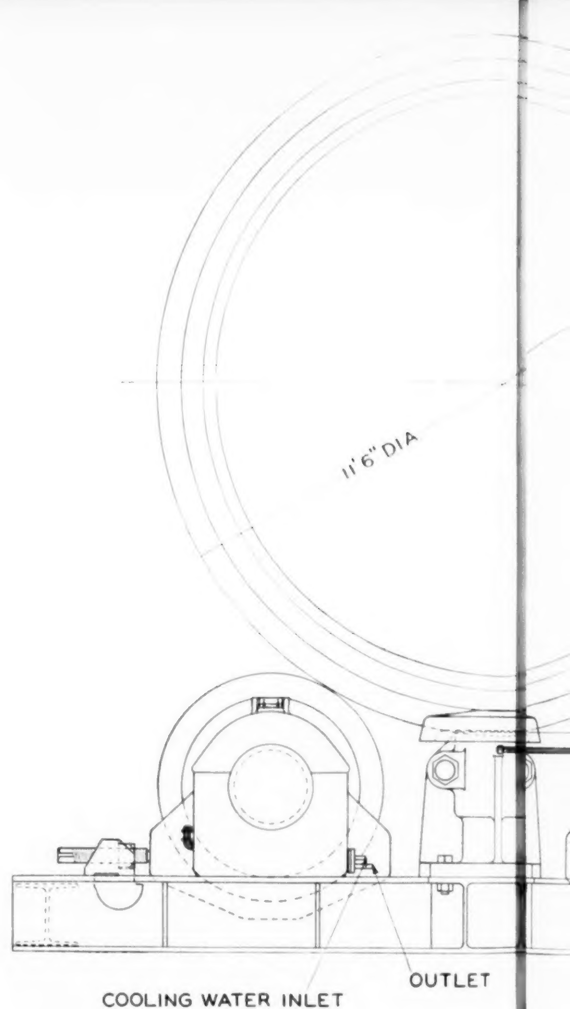
ring which carries the weight of the bevel gear and eccentric. In some machines, the bottom of the shaft is designed to fit very loosely in the eccentric so that it may be tipped from side to side. This throws all the pressure upon a small area near the top of the thickest part of the eccentric sleeve and may cause it to heat and wear rapidly unless properly lubricated.

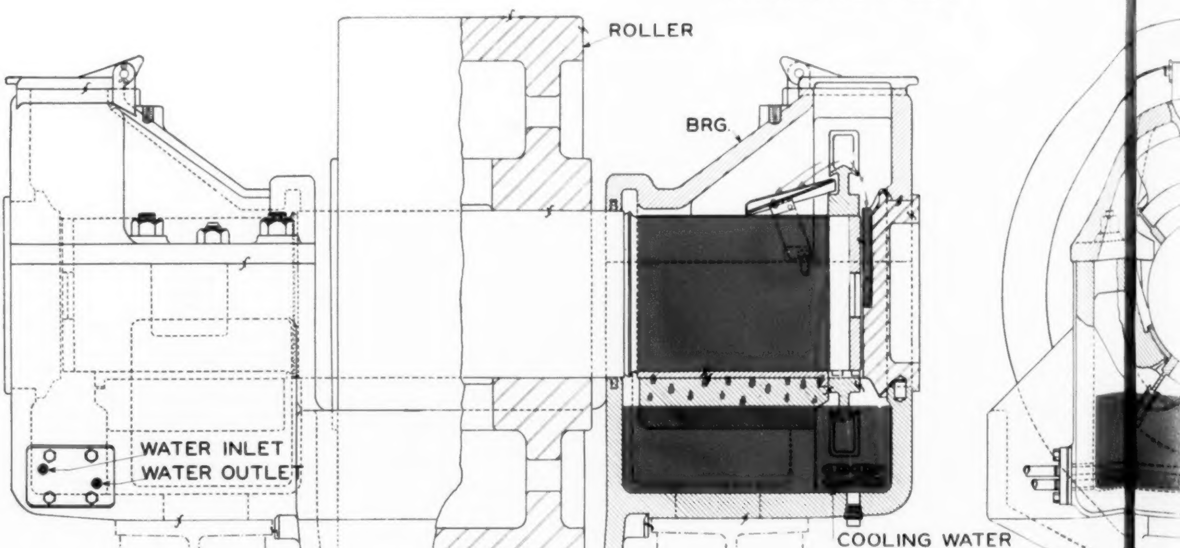
Automatic Lubrication Is Customary

Oil circulation under pressure throughout these mechanisms, is practically standard on all such equipment. This assures of continued and dependable maintenance of a sufficient flow of oil. In this way the oil can serve a twofold purpose: to carry away heat and to maintain a suitable lubricating film.

How the Oil Pump Works

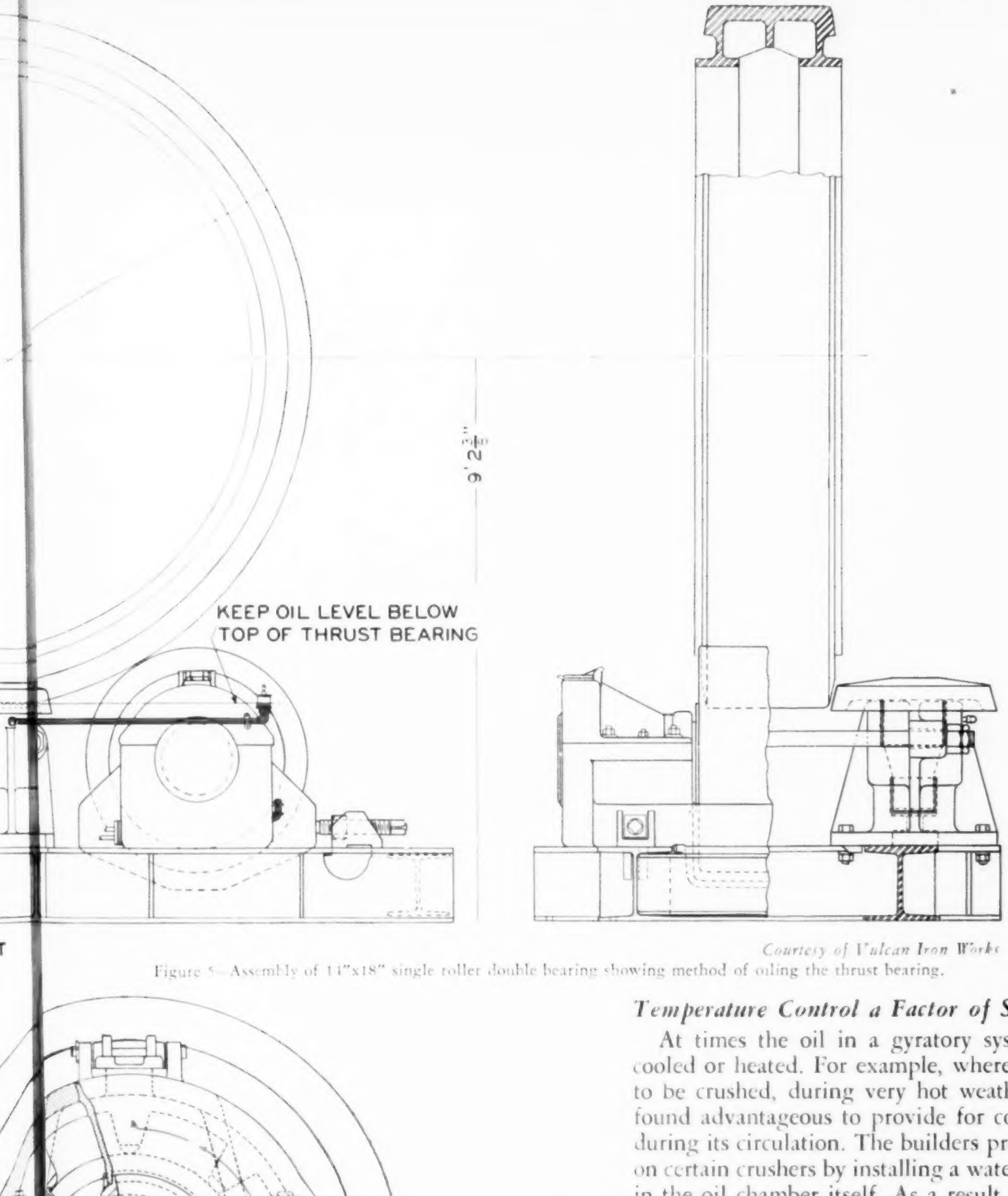
To accomplish this a suitable oil pump is located at the bottom of the crusher, either within or adjacent to the oil reservoir or chamber in the bottom plate. An ample supply of oil, from 30 to 100 gals. is contained in the system, which as a rule includes a suitable filter or strainer through which the oil passes at each circulation. Along with the general dust-proof construction of the modern gyratory, this insures against the entry and circulation of an excess of dust through the system. Meanwhile, all the lower wearing parts are served with a flood of clean, cool oil while the gyratory is operating; the oil pump starts simultaneously with the crusher, operates at a speed commensurate with the rate of crushing and stops when the crusher stops.





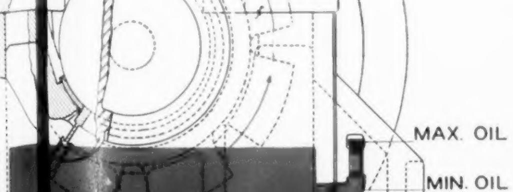
Courtesy of Vulcan Iron Works

Figure 6—The Vulcan 10"x12½" self-oiling ... by the oil wheel which is attached to the ... carry oil to the top in the pocket where ... is distributed over the shaft and surface ...



Courtesy of Vulcan Iron Works

Figure 5—Assembly of 14"x18" single roller double bearing showing method of oiling the thrust bearing.



...10"x12½ ...f-oiling single roller bearing assembly showing oil distribution ... is attached to the ...volving shaft. This wheel dips into the oil cellar to ... the pocket where it discharges it on one side to a trough from whence it ... shaft and ... surface of the end thrust disc.

Temperature Control a Factor of Safety

At times the oil in a gyratory system must be cooled or heated. For example, where hard rock is to be crushed, during very hot weather it will be found advantageous to provide for cooling the oil during its circulation. The builders provide for this on certain crushers by installing a water cooling coil in the oil chamber itself. As a result, not only can the oil in circulation be cooled where necessary, but also, it can be heated in cold weather to facilitate starting.

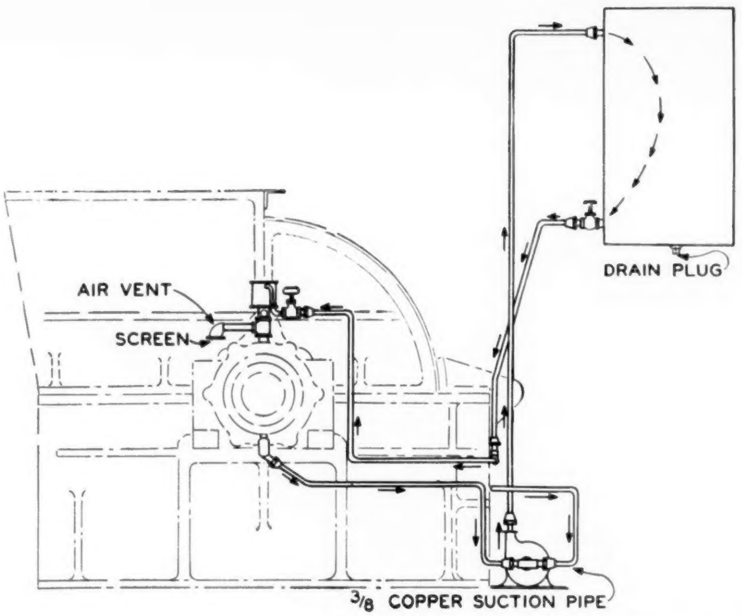
The Eccentric Sleeve

The eccentric sleeve operates wholly or partially in a bath of oil according to the design. Where no oil pressure is involved, the crusher speed is relied upon to induce oil circulation by the oil passing up through the eccentric journal over the brass wearing ring and back through passages to the reservoir beneath the shaft.

Addition of a little fresh oil once or twice a day will enable this simple oiling system to function very satisfactorily, if the reservoir is drained and cleaned regularly.

The Lubricant

A straight mineral oil of from 90 to 145 second Saybolt Universal viscosity at 210° F. will usually give the best results in average warm weather service. In cold weather, it will be advisable to use an oil of lower viscosity, especially if there is no provision for heating the oil in the system prior to starting, or during operation. Usually a viscosity of from 500 to 750 seconds Saybolt Universal at 100° F. will be best where a lighter oil is required, according to the necessity for lower pour test and greater fluidity, especially on starting.



Courtesy of Gruendler Crusher and Pulverizer Co.

Figure 7—The circulating oiling system (motor-driven) for a Gruendler heavy-duty hammer mill. End elevation.

Top Bearings and Rings

Lubrication of the top bearings, suspension and wearing rings within the dust or spider cap at the top of the main shaft of the average gyratory crusher also must be studied. The lubricant must never be so thin as to run prematurely through the bearings as this would leave their surfaces susceptible to excessive friction and wear. As a general rule, crusher oil can be used for such service or a cup grease of around No. 2 N.L.G.I.* worked penetration range.

*National Lubricating Grease Institute.

Tube Mills

Tube mills are especially adaptable for final grinding due to the highly uniform product they can produce. Mills of this type may be known as ball, tube, or compartment mills, according to their size and design. The ball mill is essentially a horizontally revolving steel drum partially filled with steel balls which continually roll to the bottom of the drum, grinding the particles of rock between and beneath them. The tube mill is very similar to the ball mill, although it is larger and is designed for finer grinding. The compartment type of mill, in turn, is a device which combines both the ball and tube mill in one cylinder.

All such mills may present lubrication difficulties because of the great weight borne by the shaft bearings and the fine grit or dust which may gain entry. Every possible precaution is, of course, taken to keep this dust out of the bearings, but it seems to get in somehow, to frequently cause considerable wear.

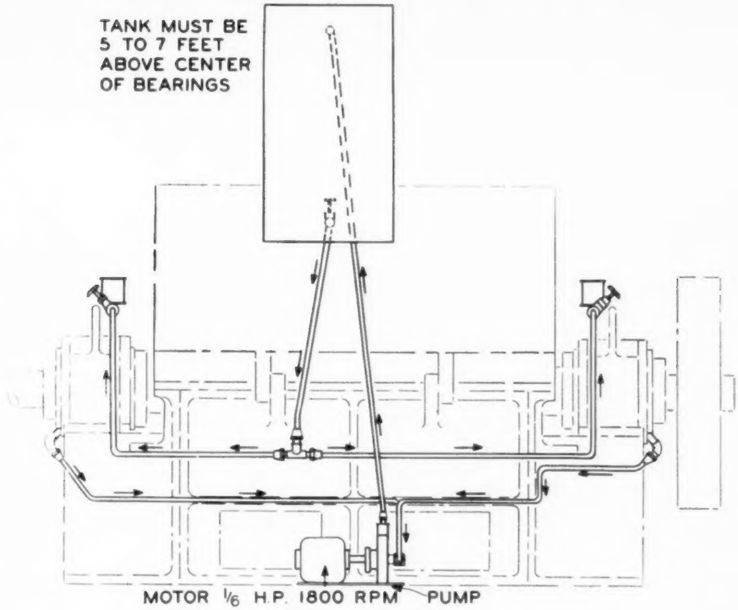
As a result the main shaft bearings are built large so that the unit loads are not excessive, but in spite of this it is necessary to use a lubricant possessing considerable body to offset reduction in viscosity due to frictional heat. In the larger newer type mills the main bearings are water-cooled.

The pinion shafts of such mills are often carried by ring-oiled bearings. Here a comparatively light bodied oil of from 200 to 300 seconds Saybolt Universal viscosity at 100° F. will normally give satisfactory service. Careful cleaning and periodic relubrication at regular intervals is suggested in the interest of bearing protection.

DRYING AND BURNING

After cement rock has passed through the preliminary crushing or grinding stage, it must be dried to drive off any contained moisture before it can be finally reduced to powder form. The product therefore goes from the crushers to the rotary dryers, or, in some plants, directly to the kilns.

Dryers are large cylinders, several feet in diameter and about ten times as long. They are located on a slight incline to cause the materials to flow forward. A fire is maintained at the lower end by means of fuel oil, gas or coal, the hot gases being blown through the dryer. Dryers are supported on two riding rings and driven by a pinion which engages a girth gear surrounding the cylinder.



Courtesy of Gruendler Crusher and Pulverizer Co.

Figure 8—The circulating oiling system (motor-driven) for a Gruendler heavy-duty hammer mill. Side elevation.

Rotary kilns are used to fuse the pulverized raw materials preparatory to final grinding.

Dryer Operation

Very low speeds prevail in dryer operation — they turn at only four to six times a minute. Speed therefore does not create any unusual lubricating problem. Bearing and gear tooth pressures, however, are comparatively high, for heavy loads must be carried. Furthermore, there is always possibility of difficulty due to the ever-present dust, and the heat which is radiated from the dryer. This may cause the trunnion bearings to run hot.

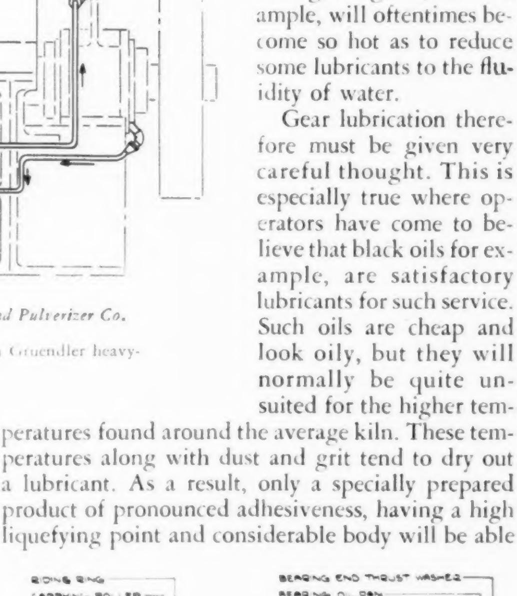
It is practicable to lubricate such parts with heavy oil or grease dependent upon the means available for application. Where grit can be kept out of the bearings oil is often preferred. It is a good idea to know the probable maximum operating temperature before selecting the lubricant. The radiated heat may thin down certain lubricants sufficiently to cause them to run out prematurely or form an inadequate lubricating film.

KILN LUBRICATION

One of the most difficult lubricating problems in the cement mill prevails on rotary kilns especially when the pressures are high. Three or more riding rings are used upon some of the larger kilns to take up these pressures. In other respects the carrying, thrust and driving mechanisms of the average kiln are the same as on the dryer.

The much higher temperatures in a kiln however, make lubrication a more difficult matter. These temperatures cause the shell to become very hot, this heat being radiated to the driving and supporting machinery. The girth gears, for example, will oftentimes become so hot as to reduce some lubricants to the fluidity of water.

Gear lubrication therefore must be given very careful thought. This is especially true where operators have come to believe that black oils for example, are satisfactory lubricants for such service. Such oils are cheap and look oily, but they will normally be quite unsuited for the higher temperatures found around the average kiln. These temperatures along with dust and grit tend to dry out a lubricant. As a result, only a specially prepared product of pronounced adhesiveness, having a high liquefying point and considerable body will be able



Courtesy of Allis-Chalmers Manufacturing Co.

Figure 9—Assembly of flood, lubricated, water-cooled carrying mechanism for Allis-Chalmers kilns, coolers and dryers.

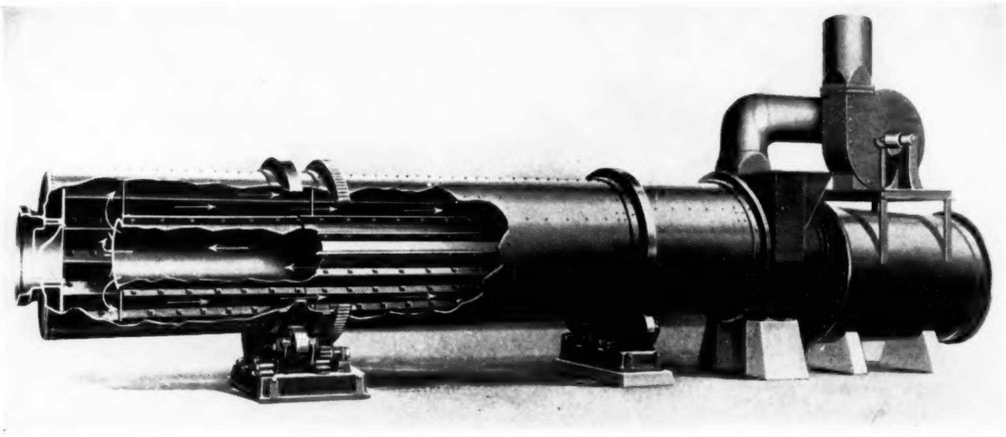


Figure 10—Details of a Ruggles-Coles rotary dryer. *Courtesy of Hardinge Company*

to prevent metallic contact and provide efficient lubrication of the gear teeth.

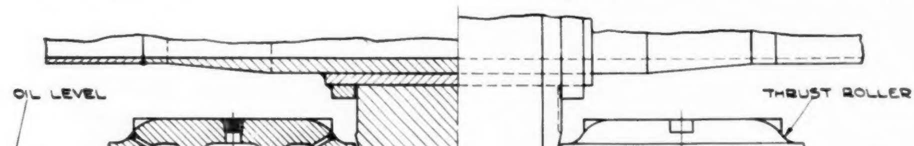
Trunnion Bearings

Lubrication of the trunnion bearings on a cement mill dryer or kiln may be difficult because:

1. The bearings are comparatively massive,
2. Heavy loads must normally be carried,
3. Trunnions often become heated as they are close to the shell and,
4. Considerable dust and grit may work in between the contact surfaces.

These conditions are met best with a grease or oil possessing considerable body and a high liquefying point. Where water-cooling of the bearings is practicable the temperature difficulty is reduced.

The direction of loading is downward. For this reason certain types of bearings have been very often lined on the bottom half only; this lining can be readily replaced when worn. As the caps of such



Courtesy of Allis-Chalmers Manufacturing Co.

Figure 11—Assembly of thrust mechanism for Allis-Chalmers kilns, coolers and dryers, with mushroom type rollers.

bearings carry no lining, they merely serve as dust shields and receptacles for the lubricant. On such bearings unit lubrication prevails.

The Self-Oiling Feature

More recently considerable study has been given to the development of means for automatic lubrication. The bearings in this case are of the two-part type, with a cap lined in very much the same manner as a standard type of plain bearing. Oil is carried in a suitable reservoir below the bearing, being distributed as the shaft rotates.

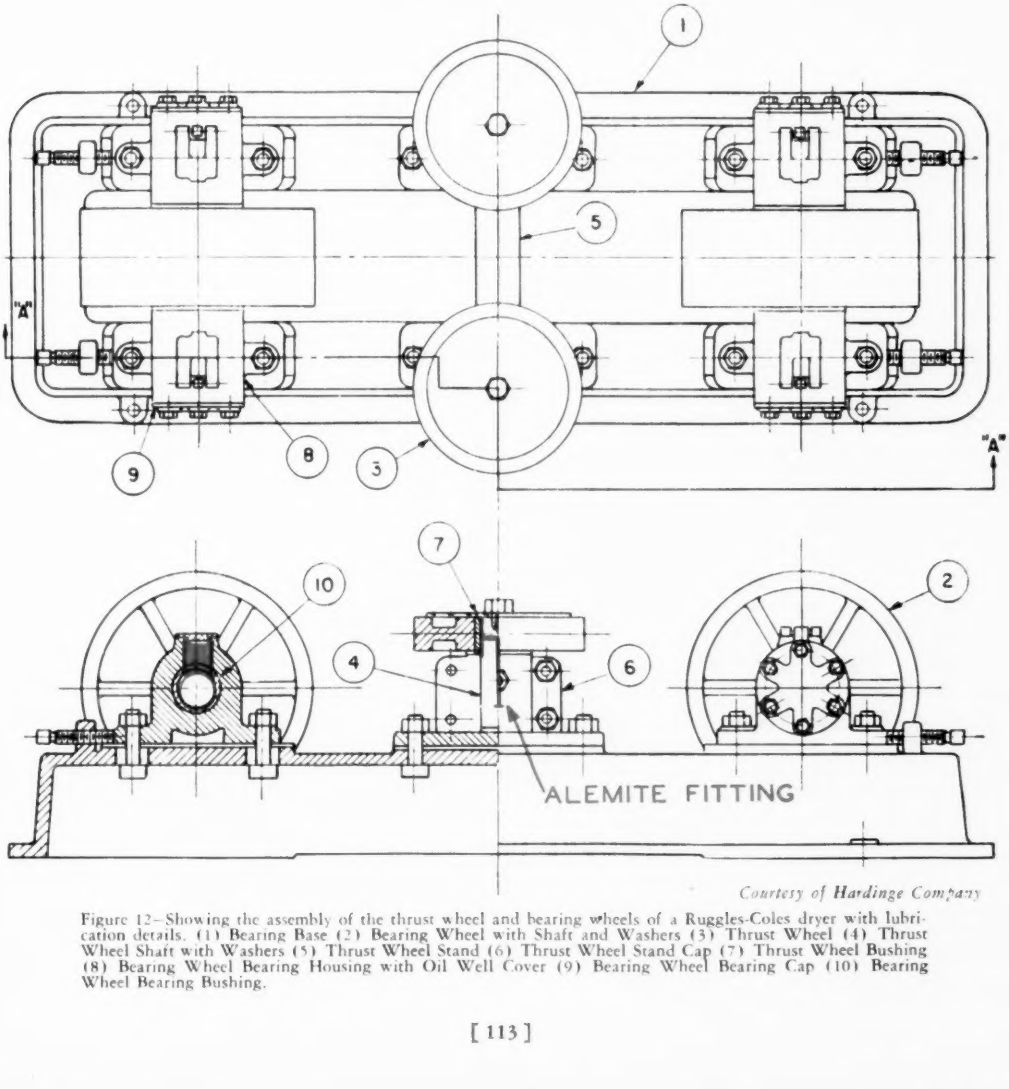
Where dippers are provided they automatically fill themselves with oil to empty same along the top of the shaft. From this point oil is distributed throughout the entire clearance space. Such bearings are normally water-cooled; as a result an oil of medium to heavy viscosity can be used. By reason of their construction and the ample oil supply available, self-oiling bearings insure effective lubrication to a high degree. There is but little opportunity for entry of abrasive foreign matter for the flood of oil is continually flushing out dust or dirt.

Roller Bearings

Roller bearings also have been adapted to trunnion design. Generally the lubricant reservoir is more limited than in a self-oiling plain bearing. Also, oil or grease may be used according to the design and the means provided for application.

Wick Feed Oilers

Wick feed oilers also assure of positive lubrication, a feature which leads to reduced maintenance and repair costs. Wick oilers are particularly adaptable to existing installations, due to their low first cost and the ease with which they can be substituted for other means of lubrication. They may require more attention, however, for the cups must be refilled with a few ounces of oil about twice daily, whereas with



Courtesy of Hardinge Company

Figure 12—Showing the assembly of the thrust wheel and bearing wheels of a Ruggles-Coles dryer with lubrication details. (1) Bearing Base (2) Bearing Wheel with Shaft and Washers (3) Thrust Wheel (4) Thrust Wheel Shaft with Washers (5) Thrust Wheel Stand (6) Thrust Wheel Stand Cap (7) Thrust Wheel Bushing (8) Bearing Wheel Bearing Housing with Oil Well Cover (9) Bearing Wheel Bearing Cap (10) Bearing Wheel Bearing Bushing.

grease lubrication certain cups or boxes will carry sufficient lubricant for several days.

It is especially advisable to check for possible oil carbonization at the bend of the wick. This will be apt to develop on bearings adjacent to the firing end of a kiln. Carbonization may reduce the flow of oil through the wick to the bearing; it can be corrected by rubbing the wick between the fingers.

The Load Conditions

Kilns are heavy and massive. Their trunnion bearings therefore, are heavily loaded. This load along with the radiated heat creates a lubricating problem which often may require special attention. Where trunnion bearings are water-jacketed, lighter lubricants may be used with good results, but when cooling is not provided for these, products often become too thin to keep the bearing surfaces apart. In such cases, unless wick feed cups or self-oiling devices are provided, the cavities in the bearings should be packed with a comparatively heavy fibrous grease which is especially prepared to withstand heat.

CLINKER COOLERS

The fused material comes from the kiln in the form of white hot clinkers which are either conveyed to a storage pile or cooled at once for grinding. Cooling may be effected at the discharge end of the kiln or the material may be passed through an individual cooler. The clinker cooler, where it is a separate unit, is quite similar in construction to the dryers and kilns.

While but little heat is actually radiated from this machine ,the riding rings and girth gears will oftentimes get quite warm through conduction. A lubricant having a fairly high liquefying point should therefore be used. It must also of course, resist the cutting and drying action of the inevitable dust. Lubricants suitable for the dryers should prove satisfactory upon the corresponding parts of the clinker coolers.

CONVEYING THE MATERIAL

Cement materials are handled to or from the various crushing devices, dryers and kilns by a screw, apron, pan or flight conveyor; by elevators, or by a suitable pressure pumping system.

Lubrication a Factor

In operating such equipment, every consideration should be given to the fact that high temperatures, and frequently considerable thrust pressure may be involved. Lubrication therefore, must not be neglected. Dust also presents a problem. In the pan or apron conveyor, for example, the roll bearings may be exposed to a sufficient extent to permit of entry of enough abrasive foreign matter to cause considerable wear. The builders have made special effort to counteract this by oil-tight and dust-tight design.

The lubricant must be chosen according to the design of the conveyor. Certain types of rollers, for example, will require oil, a suitable wick being used as a distributor. There a straight mineral oil of from 300 to 500 seconds Saybolt Universal Viscosity at 100° F. will be satisfactory. In general, such an oil also will be adaptable for the lubrication of the driving motor bearings of either ring oiled or anti-friction type, provided the housings will retain oil and abnormal temperatures do not develop.

There are other types of conveyor rollers which are designed for grease lubrication. They are usually equipped either with compression cups or pressure grease fittings. Grease serves as an effective seal at the rims of the bearings to prevent entry of dirt or dust.

Screw conveyors very often are not lubricated due to constant contact with the material being handled. In such installations shafts of tool steel running on dry cast iron bearings are favored. It is less costly to renew bearings than to try to maintain lubrication.

Where High Temperatures Prevail

Where high temperature conditions may prevail a relatively high melting point grease should be used of the type applicable to kiln or dryer trunnion bearings. Temperature frequently must be given especial attention in the lubrication of the ball bearings of pumps which are used to force cement materials through pipe lines for a considerable distance under pressure. Wherever the pump bearings are subjected to considerable heat, as for example, where flue dust or hot cement must be handled, the grease should be of adequate melting point and consistency to withstand the thinning down effects which will be promoted by high temperatures.

CONCLUSION

Treatment of the mechanical details of the production machinery used in the manufacture of cement has been briefed, with the thought that those who are particularly interested in lubrication will gain more by studying the details of the accompanying illustrations. Power equipment has not been discussed since other issues of Lubrication and certain booklets are available which are more specific. For reference see:

Air Power and Compressor Lubrication
Lubrication, Jan. 1940
Electric Motor Bearings. . Lubrication, April, 1940
Steam Cylinder Lubrication in Industry
Lubrication, April, 1942
Steam Turbine Lubricating Oils
Lubrication, May, 1944
Industrial Gears. . . . . Lubrication, Sept., 1945
Diesel Operation
Ball and Roller Bearing Lubrication
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TEXACO LUBRICATION RECOMMENDATIONS FOR CEMENT MILL MACHINERY

(Continued from Inside Front Cover)

Kilns, Dryers and Clinker Coolers

DRYERS	
Driving Pinions and Girth Gears	
Hand Lubricated	Texaco Crater No. 1 or No. 2
Bath Oiled	Texaco No. 629 Oil
Trunnions	Texaco Taurak Grease or Hytex Grease No. 6 or No. 8
GEAR AND PINION BEARINGS	
Grease Lubricated	Texaco Taurak Grease or Hytex Grease No. 3 or No. 6
Oil Lubricated	Texaco Pelican Oil or Texaco No. 629 Oil
KILNS AND COOLERS	
Driving Pinions and Girth Gears	
Hand Lubricated	Texaco Crater No. 1 or No. 2
Bath Oiled	Texaco No. 629 Oil or Texaco Pelican Oil
Trunnion Bearings	
Grease Lubricated	Texaco Taurak Grease or Hytex Grease No. 6 or No. 8
Wick Feeds or Bath Oiled	Texaco 629 Oil or Texaco Pelican Oil
Gear, Pinion and Roll Bearings	
Oil Lubricated	Texaco Pinnacle Min. Cyl. Oil or Texaco Pelican Oil
Grease Lubricated	Texaco Taurak Grease or Texaco Hytex Grease No. 6 or No. 7
CONVEYING EQUIPMENT	
Roll Bearings (According to Temperature and means of lubrication)	Texaco Marfak No. 0 Texaco Cup Grease or Texaco Star Grease

NOTE—Wherever cold operation is involved, if necessary, substitute TEXACO Star Grease for TEXACO Cup Grease of the proper consistency.

ROLLER OR BALL BEARINGS	
(Grease Lubricated)	
Kilns	Texaco Marfak No. 3 or No. 5
Conveyors and Tube Mills	Texaco Marfak No. 1, No. 3 or Texaco Starfak Grease H
(Oil Lubricated)	
Kilns and Tube Mills	Texaco Pinnacle Min. Cyl. Oil
Conveyors	Texaco Altair Oil or Aries Oil